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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Torma et al.
Serial No. TO BE ASSIGNED
Corresponding to PCT/FI99/00451, filed 27 May 1999
Filed: October 27, 2000 Docket No.: 796.372USW1
Title: MULTIPLEXING IN A PDH TELECOMMUNICATIONS NETWORK

CERTIFICATE UNDER 37 C.F.R. 1.10:

'Express Mail' mailing number: EL492432178US
Date of Deposit: October 27, 2000

The undersigned hereby certifies that this Transmittal Letter and the paper or fee, as described herein, are being deposited with the United States Postal Service 'Express Mail Post Office To Addressee' service under 37 CFR 1.10 and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231

By: Susan Heuiser
Susan Heuiser

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

REQUEST FOR CONTINUATION OF AN INTERNATIONAL APPLICATION
UNDER 37 C.F.R. §1.53(b)

This is a request for filing a continuation application under 37 C.F.R. §1.53(b) of prior pending international application number PCT/FI99/00451 filed on 27 May 1999 entitled MULTIPLEXING IN A PDH TELECOMMUNICATIONS NETWORK, which designated the United States.

1. ☒ Enclosed is a patent application containing 9 pages of specification, 2 pages of claims and 4 sheet(s) of drawings.
2. ☒ A preliminary amendment is enclosed.
3. ☒ Please amend the specification by inserting the following paragraph after the title:

This application is a continuation of international application serial number PCT/FI99/00451, filed 27 May 1999.

4. ☐ Small entity status
 - a. ☐ A small entity statement is enclosed.
 - b. ☐ A small entity statement was filed in the prior non provisional application.
 - c. ☐ is no longer claimed.

The filing fee is calculated below

CLAIMS				
	Number Filed	Number Extra	Rate	Fee
Total Claims	8		X \$18.00	\$
Indep. Claims	2		X \$78.00	\$
Multiply Dependent Claims				\$
Basic Fee				\$ 710.00
TOTAL				\$ 710.00

5. ☒ Payment of filing fees
☒ A check in the amount of \$710.00 is enclosed.
☐ Please charge Deposit Account Number 50-1038.
☐ Is deferred.
6. ☒ The Commissioner is hereby authorized to credit any overpayment or charge any fees required under 37 C.F.R. §1.16-1.18 to Deposit Account Number 50-1038.
7. ☒ The priority of Finnish application number 981189, filed 28 May 1998, is claimed under 35 U.S.C. §119.
☒ A certified copy of the priority application is enclosed.
8. ☒ A SIGNED Declaration is enclosed.
9. ☒ An assignment of the invention to Nokia Networks OY, Recordation Form Cover Sheet (Patents Only) and a check in the amount of \$40.
10. ☒ An Information Disclosure Statement, Form PTO 1449 and copies of 7 citations are enclosed.
11. ☒ Correspondence Address
- Altera Law Group
10749 Bren Road East
Minneapolis, Minnesota 55343
12. ☒ Address all correspondence to Michael B. Lasky.
13. ☒ Also enclosed: Abstract
14. ☒ A return postcard is enclosed.

Respectfully submitted,

Altera Law Group, LLC
10749 Bren Road East, Opus 2
Minneapolis, MN 55343
(952) 912-0527

Date: October 27, 2000

By: 

Michael B. Lasky
Reg. No. 29,555
MBL/jsc

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Torma et al.	Examiner:	UNKNOWN
Serial No.:	TO BE ASSIGNED	Group Art Unit:	TO BE ASSIGNED
Filed:	October 27, 2000	Docket No.:	796.372USW1
Title:	MULTIPLEXING IN A PDH TELECOMMUNICATIONS NETWORK		

CERTIFICATE UNDER 37 C.F.R. 1.10:

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By: Susan Heuiser

Susan Heuiser

PRELIMINARY AMENDMENT

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Please enter the following preliminary amendment into the above-referenced application.

ABSTRACT

Please insert the attached abstract into the application as the last page thereof.

[illegible]

If a telephone conference would be helpful in resolving any issues concerning this communication, please contact Applicant's attorney of record, Michael B. Lasky at 952-912-0527.

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Multiplexing in a PDH telecommunications network

Field of the Invention

5 The present invention relates generally to data transfer implemented in a conventional PDH (Plesiochronous Digital Hierarchy) network. More specifically, the invention relates to how information streams in more modern transmission systems, particularly cell streams in ATM systems, can be transferred across a PDH network.

10 Background of the Invention

PDH is still today the predominating multiplexing hierarchy, even though it was taken into global use already in the 1970s. A multiplexing hierarchy means that an upper hierarchy level system having a higher capacity is constructed by combining a given number of lower hierarchy level systems by means of time division multiplexing. There are three different versions of multiplexing hierarchy, one of which is used in Europe, one in the USA and one in Japan. The European system is also used in most parts of the rest of the world.

15 In the European multiplexing system, 31 64 kbit/s channels and one frame alignment word are multiplexed into a data stream having a rate 2048 kbit/s. This first hierarchy level signal is called E1. In the European system, the upper hierarchy level system is constructed by multiplexing four lower-level signals.

20 In North America and Japan, on the other hand, 24 channels and one frame synchronizing bit are multiplexed into a data stream having a rate 1544 kbit/s. This first hierarchy level signal is called T1. In the American system, the second hierarchy level system is constructed from four first level systems, the third level system from seven second level systems and the fourth level system from three third level systems. In Japan, the hierarchy is otherwise similar, but the third level system is constructed from five second level systems.

25 Particularly in trunk connections, however, there has been a shift to using more modern multiplexing systems that offer, for instance, better network management (e.g. easier drop and add functions for tributaries). Such newer multiplexing systems include SDH (Synchronous Digital Hierarchy) and SONET (Synchronous Optical Network). Like PDH, also SDH and SONET are

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based on 64 kbit/s channels in accordance with the PCM technique, and the conventional PCM signals of the PDH network can be transferred in transmission frames in accordance with the new multiplexing hierarchies.

However, an access network nowadays typically follows a $n \times E1$ or
5 $n \times T1$ multiplexing hierarchy (n is an integer) on account of, for example, the smaller capacity requirement of the access network and the fact that in such a case, the same advantages are gained in the access network as with SDH in the core network (since the multiplexing between the different hierarchy levels is omitted). An additional reason for the hierarchy of an access network is that
10 an access network uses a large number of radio connections, and thus valuable bandwidth is saved by means of the $n \times E1$ hierarchy. (Typical values for n are 2, 4, 8 and 16.)

Figure 1 depicts how in a conventional PDH network element incoming signals are transferred to a common transmission link TL, which can
15 be constituted for example by a radio path, copper cable or optical fibre. The example only deals with one transmission direction (from left to right in the figure). The reverse operations are carried out in the other transmission direction. Standard PCM signals (a total of n signals) arrive at the network element from various transmission links $IN1 \dots INn$; in this exemplary case the signals
20 are assumed to be E1 signals (but they can also be for example T1 signals). Each incoming signal has a dedicated input interface $IFU1 \dots IFUn$ in an interface unit IFU, each interface performing the physical adaptation of the corresponding signal to the network element. From the interface unit, each incoming signal is connected to a frame multiplexer 11, in which a
25 transmission frame for the next link TL is formed by multiplexing the incoming (payload) signals (n signals) and in addition a number of other signals that are denoted in the figure with a common reference HEADER DATA. Hence, a serial signal is obtained from the output of the frame multiplexer, and this signal is supplied to a transmission device 12, which is connected to link TL.
30 Depending on the transmission medium, the transmission device still shapes the signal in different ways, but this is no longer essential to the invention.

Figure 2 is an exemplary illustration of a frame structure that can be constructed for example by a frame multiplexer multiplexing 4 incoming 2
Mbit/s signals (E1 signals). In the example of the figure, the frame is divided
35 into 16 sets each having 64 bits. The bits are divided into payload bits (D0-D3) and overhead bits. The payload bits are denoted in such a way that bit D_i

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($i=0,1,2,3$) belongs to the incoming E1 signal having the serial number i . The overhead bits, which are denoted by a grey zone in the figure, typically include frame alignment bits FA, justification control bits JC, additional channel bits AC, internal communication channel bits IC, and bits ED (error detection) and FS (fec syndrome) used for error detection and error correction. The bits used for rate difference equalization are not shown in the figure. Thus, a transmission frame leaving the frame multiplexer has a basic structure consisting of a payload portion (white zone in the figure), having a transmission capacity of e.g. $n \times E1$ or $n \times T1$, and a header portion (grey zone in the figure) in which additional information is transferred.

If it is desired to utilize a PDH network element in accordance with Figure 1, having a plurality of 2 Mbit/s interfaces, for transfer of e.g. ATM cells, in accordance with the currently used technology this requires addition of an ATM adaptation element AE in accordance with Figure 3, including for example an inverse multiplexer I-MUX. If the ATM cells are transported for example in a STM-1 transmission module in accordance with the SDH hierarchy, the element has, in compliance with STM-1 capacity, a standard 155 Mbit/s interface unit AIU for the incoming optical signal. In the interface unit, the incoming optical signal is converted into electrical form and the frame structure is disassembled, so that a cell stream is obtained at the output of the interface unit which is connected to a rate adaptation unit TCU. In the rate adaptation unit, the bit rate of the incoming cell stream is adapted to be correct in view of the transmission device 12 by adding or removing idle cells, i.e. cells not carrying a payload. Thereafter, the rate-adapted cell stream is connected to the inverse multiplexer I-MUX, constructing one logical link from n outgoing parallel links ($OL1 \dots OLn$).

Inverse multiplexing is an operation specified by the ATM Forum; by means of it a high-rate cell stream can be transferred through several parallel links. In this way, user access to an ATM network can be offered or ATM network elements can be interconnected through conventional PDH links, e.g. E1 links, which as a group offer the necessary transmission capacity. In inverse multiplexing, the cells are cyclically multiplexed onto links grouped to form one logical link whose transmission capacity corresponds approximately to the sum of the transmission capacities of the individual links belonging to the group. At the receiving end, compatible inverse demultiplexing is needed to reconstruct the original cell stream, and thus compatible devices must be

added at both ends of the link or connection in order to transfer ATM cells.

In the transmission direction, the inverse multiplexer I-MUX distributes the cells arriving from the ATM layer cyclically one at a time to the links OL1...OLn belonging to the group. Moreover, the transmitting multiplexer adds
5 special cells to the cell stream of each parallel link, on the basis of which the receiving end can reconstruct the original cell stream. Cells are transmitted continuously, and thus if cells are not received continuously, the inverse multiplexer adds to the cell streams special padding cells, so that a continuous cell stream is obtained at the physical layer.

10 Since inverse multiplexing does not relate to the actual invention, it will not be described in detail in this context. Inverse multiplexing has been described in ATM Forum specification AF-PHY-0086.00, in which the interested reader will find a more detailed description of the subject.

From the inverse multiplexer I-MUX, the signals of all links
15 belonging to the group are connected via output interfaces OL1...OLn out from the ATM adaptation element. If the signals are E1 signals and the interfaces are in accordance with the ITU-T recommendation G.703, the signals can thereafter be directly applied to the input interfaces IFU1...IFUn of the frame multiplexer 11 of the transmission device in accordance with Figure 1. It has
20 been presumed in the figure that the inverse multiplexer uses all input interfaces of the frame multiplexer.

However, the solution described above, utilizing inverse multiplexing/demultiplexing, has certain drawbacks. First, adding an inverse multiplexer and demultiplexer to the link or connection renders the solution expensive and
25 complex. Furthermore, a separate ATM adaptation element will be space-consuming, as it requires its own frame in the equipment room. This is of significance particularly in newer systems in which the transmission devices are located outdoors, for example incorporated into subscriber multiplexers in street cabinets or integrated into base stations of a mobile communications
30 system, which stations are typically located on roofs or walls of buildings.

Summary of the Invention

It is an object of the invention to eliminate the drawbacks described above and to provide a PDH network element capable of flexibly using its PDH
35 capacity, when necessary, also for transfer of a packet data stream, particularly ATM cells, without any inverse multiplexing being needed.

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Since the solution in accordance with the invention enables omission of inverse multiplexing, the auxiliary/peripheral components required

[illegible]

by the inverse multiplexer/demultiplexer, such as cabinets or power sources, can simultaneously be omitted. Moreover, the number of cables and interfaces internal to the network element can be reduced. On account of these changes, the overall reliability of the network element is improved and installation and
5 commissioning work is simplified.

ATM use also saves some transmission capacity, since the cells can be packed directly into the payload portion of the transmission frame (without any need to add other information into the cell stream).

10 **Brief description of the drawings**

The invention and its preferred embodiments will be described in greater detail in the following with reference to Figures 4...7 in examples in accordance with the accompanying drawings, in which

Figure 1 illustrates a conventional PDH network element,

15 Figure 2 illustrates an outbound transmission frame of the device in accordance with Figure 1,

Figure 3 illustrates a known way of transferring ATM cells in a PDH network,

20 Figure 4 shows a network element in accordance with the invention by means of which both PDH signals and ATM cells can be transferred,

Figure 5 shows in greater detail the frame multiplexer of the network element of Figure 4,

Figures 6 and 7 are exemplary alternatives for the outbound transmission frame in the network element of Figure 4.

25

Detailed Description of the Invention

Figure 4 is an illustration of the principle of the solution of a network element in accordance with the invention. The frame multiplexing unit FMU of the network element is implemented in such a way that alternatively either
30 PCM signals in accordance with Figure 1 in a known manner, an ATM cell stream through an interface unit and a rate adaptation unit as described above, or both PCM signals and a cell stream can be connected thereto. When cells are transferred, the cell stream is connected from the output of the rate adaptation unit TCU directly to one input of the frame multiplexing unit.
35 The outbound bit rate to the link is the same in all cases, since the same frame structure is used in all cases.

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The frame multiplexing unit is configured with control unit CU depending on whether it operates in the PDH mode, ATM mode or combined PDH/ATM mode in which the transmission frame comprises both PDH signals and ATM cells. If the payload capacity of the outbound transmission frame is for example $16 \times E1$ (16 2 Mbit/s signals), the capacity can be divided for example in such a way that 3 E1 signals are transferred in the frame, and additionally a capacity corresponding to 13 E1 signals is allocated to ATM cells. Thus, the payload capacity is divided into two parts, one of which is allocated to three E1 signals and the other to ATM traffic. Generally, X E1 or T1 signals ($0 \leq X \leq N$) are transferred in the transmission frame, which allows ATM traffic a capacity corresponding to $(N-X)$ E1 or T1 signals respectively.

In the rate adaptation unit, the bit rate of the cell stream is adapted to correspond to the capacity allocated to the cell stream in the transmission frame. This is effected by adding or removing idle cells. After the rate adaptation, the cells are written into a buffer BF one byte at a time, wherefrom data is read out one bit at a time to the frame multiplexer FM. The rate adaptation unit is capable of detecting cell boundaries, but the frame

multiplexer processes the cells as a bit stream only. When the frame counter has read out a bit from the buffer, it gives via an ENABLE line a command for transferring the data in the buffer one memory location forward. However, the buffer need not necessarily be implemented as a physical queue in which all
5 cells are continually moved forward, but the buffer can be implemented as a ring, for example, in which the pertinent reading point is indicated by a pointer. What is essential is that the ATM cells are in a logical queue wherefrom their data is read out in succession.

Figures 6 and 7 show two examples of a transmission frame to be
10 sent to link TL. A frame in accordance with Figure 2 is still used as an example, having 16 sets each comprising 64 bits. In the example of Figure 6, the entire payload capacity of the frame is allocated for ATM use, whereas in the example of Figure 7 a capacity corresponding to two E1 signals (half of the payload) is allocated to ATM use, and additionally two E1 signals (D2 and D3)
15 are transferred in the transmission frame. The bits of the different parts should preferably be located in the frame in such a way that within the part allocated to PCM signals, one bit is taken alternately from each signal to be multiplexed, and after one bit has been taken from each PCM signal, a corresponding quantity of bits is taken from the cell stream weighted by the ratio of the
20 capacity allocated to the cell stream and to the PCM signals (by the capacity ratio of the zones). This allows the length of the buffers to be kept at minimum. Figure 7 illustrates such an alternative.

The control unit gives the frame multiplexer set data indicating e.g. bit by bit in the frame whether said bit position is intended for PDH or ATM
25 use. Information is thus obtained for all bit positions indicated by the frame counter on the input wherefrom a bit is to be read out into said bit position.

In the receiving direction, a similarly configured demultiplexer provided with the same settings performs demultiplexing, as a result of which the bits of the ATM cells are obtained in the receiving buffer in the correct
30 order and the PCM signals are obtained at correct outgoing circuits.

Even though the invention has been explained in the foregoing with reference to examples in accordance with the accompanying drawings, it is obvious that the invention is not restricted thereto, but it can be modified within the scope of the inventive idea set forth in the appended claims. In principle, it
35 is possible for example to divide the payload portion into more than two parts and transfer thereby more than one packet or cell stream. In practice this is

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unlikely, however, on account of the high capacity requirement of an ATM network. The set of packet data streams stated in the appended claims thus typically comprises only one data stream. The same alternatives also apply to a set of PCM signals, even though in this case it is more likely that the set

5 comprises more than one PCM signal. The idea of the invention can also be applied to substreams of a first level signal. In other words, the capacity division between the parts of the payload can also be changed by a smaller increment/decrement than an increment/decrement corresponding to one E1 or T1 signal, for example an increment/decrement corresponding to one 64

10 kbit/s channel or even a subchannel thereof. The type of the network element can also vary in many ways; it can have one or more incoming and outgoing links, the link capacities can vary, and the element can also be a subscriber terminal.

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Claims:

1. A multiplexing arrangement in a network element of a telecommunications network, comprising

5 - a first interface unit (IFU) for receiving standard PCM signals in the network element, and

- multiplexing means (FMU) for multiplexing said PCM signals on a time-division basis into a transmission frame, the total capacity of the payload portion of the frame substantially corresponding to the capacity of N PCM signals,

10 c h a r a c t e r i z e d in that

- the multiplexing means are implemented as configurable in such a way that the total capacity of the payload portion can be divided between at least two parts of variable capacity in such a way that each part can be allocated a desired portion of the total capacity of the payload portion in accordance with the current transmission requirement, and that

15 - a part of the payload depending on the desired capacity is allocated to at least one traffic source from a group in which a number of PCM signals constitutes a first traffic source and a number of packet data streams constitutes a second traffic source.

20 2. An arrangement as claimed in claim 1, c h a r a c t e r i z e d in that a portion of the total capacity of the transmission frame corresponding to the capacity required by one PCM signal multiplied by an integer is allocated to all traffic sources using the same transmission frame.

25 3. An arrangement as claimed in claim 1, in which standard PCM signals and at least one packet data stream are received in the network element, c h a r a c t e r i z e d in that

- the total capacity of the payload portion is divided between M ($M < N$) PCM signals and one packet data stream, the data stream being allocated a capacity corresponding to $(N-M)$ PCM signals, and that

30 - rate adaptation by means of which the bit rate of the packet stream is adapted to correspond to the capacity allocated to it is performed on the packet stream.

4. An arrangement as claimed in claim 1, c h a r a c t e r i z e d in that at least one of the traffic sources is constituted by an ATM cell stream.

35 5. An arrangement as claimed in claim 3, c h a r a c t e r i z e d in that bits of each part are interleaved in the payload portion, and that of the bits

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8. A network element as claimed in claim 7, characterized in that the network element additionally comprises a second interface unit (AIU, TCU) for receiving a packet data stream, said interface unit comprising rate adaptation means (TCU) for adapting the bit rate of the packet data stream to correspond to the capacity of the payload portion allocated to the packet stream, the output of said rate adaptation means being directly connected to said multiplexing means.

For

The invention relates to a multiplexing method used in a PDH network. Standard PCM signals are received in the network element, at least some of which are multiplexed on a time-division basis into the same outbound transmission frame, the capacity of the payload portion of the frame substantially corresponding to the capacity required by N PCM signals. In order that ATM cells may be transferred more advantageously than heretofore through an existing PDH network, the multiplexing is implemented as configurable in such a way that the total capacity of the payload portion can be divided between at least two parts of variable capacity in such a way that each part can be allocated a desired portion of the total capacity of the payload portion in accordance with the current transmission requirement. A part of the payload depending on the desired capacity is allocated to at least one traffic source from a group in which a number of PCM signals constitutes a first traffic source and a number of packet data streams constitutes a second traffic source. The invention is specifically intended for transferring ATM traffic through a PDH network.

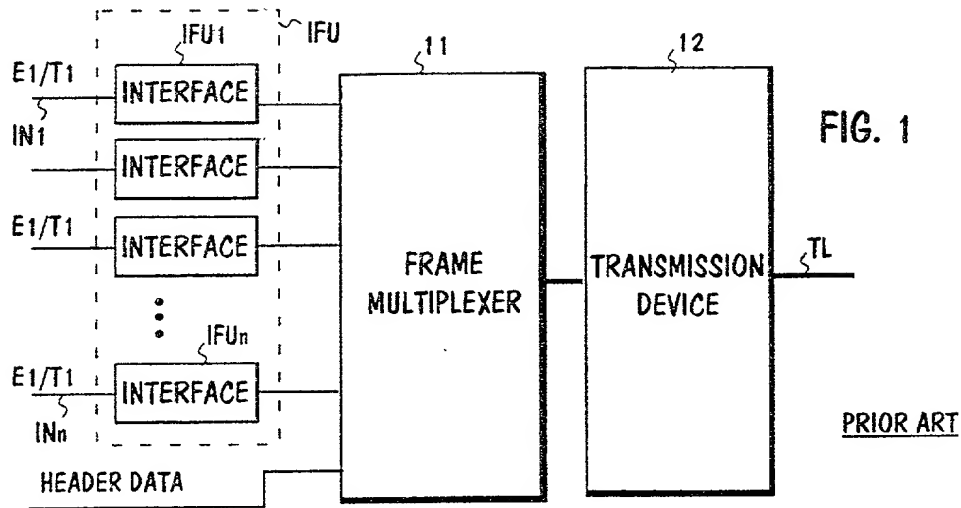


FIG. 2
PRIOR ART

SET	0	1	2	3	4	5	6	7	8	9	10	11	12	13		61	62	63
0	FA	FA	FA	FA	FA	FA	FA	FA	D0	D1	D2	D3	D0	D1		D1	D2	D3
1	AC	AC	AC	AC	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
2	AC	AC	AC	AC	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
4	TC	TC	TC	TC	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
5	AC	AC	AC	AC	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
6	ED	ED	ED	ED	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
7	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
8	TC	TC	TC	TC	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
9	AC	AC	AC	AC	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
10	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
11	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
12	AC	AC	AC	AC	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
13	TC	TC	TC	TC	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
14	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1	D2	D3	D0	D1		D1	D2	D3
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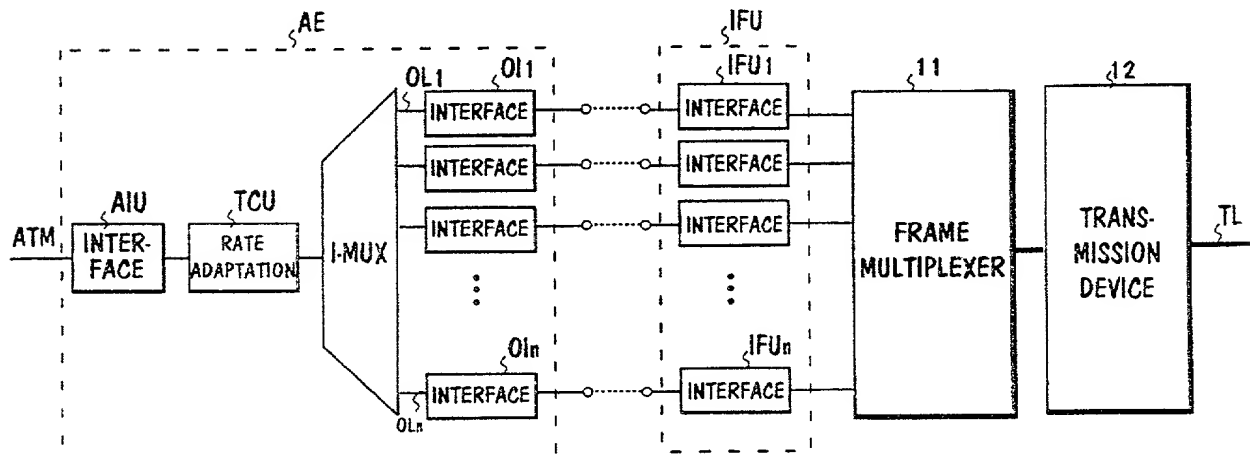


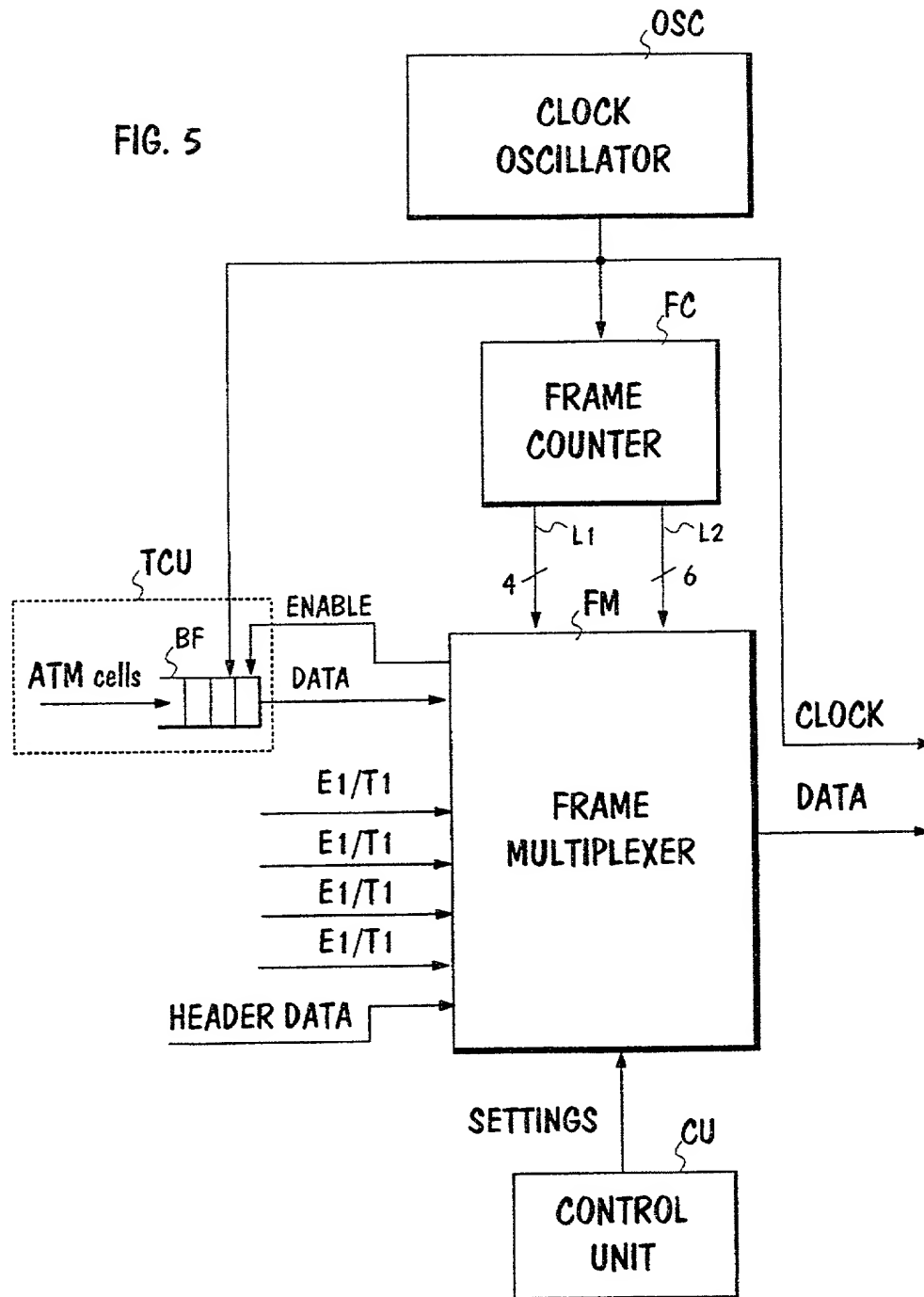
FIG. 3 PRIOR ART



BIT NUMBER →																		
SET	0	1	2	3	4	5	6	7	8	9	10	11	12	13		61	62	63
0	FA	FA							ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
1	FC	FC			ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
2	FE	FE			ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
3	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
4	FC	FC			ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
5	FE	FE			ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
6	FA	FA			ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
7	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
8	FC	FC			ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
9	FE	FE			ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
10	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
11	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
12	FC	FC			ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
13	FE	FE							ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
14	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM
15	FA	FA							ATM	ATM	ATM	ATM	ATM	ATM		ATM	ATM	ATM

FIG. 6

FIG. 5



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BIT NUMBER →

SET	0	1	2	3	4	5	6	7	8	9	10	11	12	13		61	62	63
0	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
1	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
2	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
3	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
4	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
5	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
6	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
7	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
8	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
9	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
10	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
11	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
12	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
13	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
14	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3
15	ATM	ATM	ATM	ATM	ATM	ATM	D2	D3	ATM	ATM	D2	D3	ATM	ATM		ATM	D2	D3

FIG. 7

Altera Reference No.: 796,372USW1

Altera Law Group, LLC**Declaration and Power of Attorney Patent Application
(Design or Utility)**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:
MULTIPLEXING IN A PDH TELECOMMUNICATIONS NETWORK

the specification of which

- ☐ is referred to by Altera reference number on a separate document
☒ is attached hereto
☐ was filed on _____ as application serial no. _____ and or PCT International
 Application number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information know to me to be material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or 35 U.S.C. §365(b) of any foreign application(s) for patent or inventor's certificate, or 35 U.S.C. §365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate of PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)		
Number 981189	Country Finland	Day/Month/Year Filed 28 May 1998
Number	Country	Day/Month/Year Filed
Number	Country	Day/Month/Year Filed

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below:

Prior Provisional Application(s)	
Serial Number	Day/Month/Year Filing Date
Serial Number	Day/Month/Year Filing Date
Serial Number	Day/Month/Year Filing Date

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s), or under 35 U.S.C. §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

Prior U.S. or International Application(s)		
Serial Number PCT/FI99/00451	Day/Month/Year Filed 27 May 1999	Status (patented, pending, abandoned) Pending
Serial Number	Day/Month/Year Filed	Status (patented, pending, abandoned)
Serial Number	Day/Month/Year Filed	Status (patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Altera Reference No.: 796.372USW1

Power of Attorney

As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

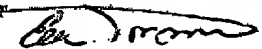
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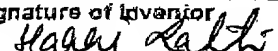
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I hereby authorize them or others whom they may appoint to act and rely on instructions from and communicate directly with the person/organization who/which first sends this case to them and by whom/which I hereby declare that I have consented after full disclosure to be represented unless/until I instruct Altera Law Group, LLC otherwise.

Please direct all correspondence in this case to Altera Law Group, LLC at the address indicated below:

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